

ECE-486 Homework 1, Spring 2009

1. A digital scope samples a signal at 210 samples/second. The signal has been corrupted by a 60 Hz line voltage. List the discrete time frequencies associated with the first 10 harmonics of the 60 Hz signal. (Include both the positive and negative frequency terms associated with these harmonics.) Specify all of your frequencies in the range $-0.5 < f \leq 0.5$.
2. Let $g_1(t)$, $g_2(t)$, and $g_3(t)$ be cosine functions with frequencies of 3 Hz, 7 Hz, and 13 Hz respectively.

$$g_1(t) = \cos(6\pi t)$$

$$g_2(t) = \cos(14\pi t)$$

$$g_3(t) = \cos(26\pi t)$$

- (a) Use Matlab or Mathcad to produce a quality plot of the above three functions (on the same set of axes) for $0 < t < 1$ sec.
 - (b) For each of the functions (on the same plot), place a plot symbol showing the sample values obtained when the waveforms are sampled using a sampling rate of 10 samples/sec.
 - (c) Note that each of the above sampled waveforms have exactly the same sample value for any value of n . Identify all other (continuous-time) frequencies for which this will be true.
3. A discrete-time system is described by

$$y(n) = \ln(2 + |x(n)|)$$

Determine (and justify!) whether the system is:

- (a) Linear or nonlinear
 - (b) Time invariant or time varying
 - (c) Causal or noncausal
 - (d) Stable or unstable
4. Repeat problem 3 for the system described by

$$y(n) = x(n) \cos(\omega_0 n).$$

5. Repeat problem 3 for the system described by

$$y(n) = \beta + \sum_{\ell=0}^3 x(n - \ell) \quad \beta \text{ is a non-zero constant.}$$